The Low Terms in Co VI

I. S. Bowen
California Institute of Technology, Pasadena, California

(Received April 8, 1938)

The present paper reports a continuation[1] of the investigation of the low metastable terms in the high stages of ionization of the elements of the first long period. Table I gives the classification of about 100 lines representing transitions between terms of the d^4 and d^34p con-

Table I. *Classified lines of* Co VI.

Int.	λ	ν	d^4 — d^34p
1	266.114	375,779	$^5D_2-(^4P)^5P_3$
6	266.498	375,237	$^5D_3-(^4P)^5P_3$
4	266.634	375,046	$^5D_1-(^4P)^5P_2$
4	266.905	374,665	$^5D_2-(^4P)^5P_2$
8	266.973	374,570	$^5D_4-(^4P)^5P_3$
			$^5D_0-(^4P)^5P_1$
5	267.131	374,348	$^5D_1-(^4P)^5P_1$
6	267.297	374,116	$^5D_3-(^4P)^5P_2$
5	267.402	373,969	$^5D_2-(^4P)^5P_1$
5	271.595	368,195	$^3H_4-(^2H)^3G_3$
0	271.711	368,038	$^3H_4-(^2H)^3G_4$
6	272.022	367,617	$^3H_5-(^2H)^3G_4$
0	272.149	367,446	$^3H_5-(^2H)^3G_5$
7	272.481	366,998	$^3H_6-(^2H)^3G_5$
1	274.534	364,254	$^5D_4-(^4F)^3G_5$
5	275.818	362,558	$^3G_3-(^2H)^3G_3$
3	275.944	362,392	$^3G_3-(^2H)^3G_4$
2	276.167	362,100	$^3G_4-(^2H)^3G_3$
7	276.285	361,945	$^3G_4-(^2H)^3G_4$
0	276.424	361,763	$^3G_4-(^2H)^3G_5$
4	276.570	361,572	$^3G_5-(^2H)^3G_4$
7	276.721	361.375	$^3G_5-(^2H)^3G_5$
5	277.079	360,908	$^5D_2-(^4F)^3D_3$
4	277.579	360,258	$^5D_1-(^4F)^3D_2$
2	277.853	359,903	$^5D_0-(^4F)^3D_1$
			$^5D_2-(^4F)^3D_2$
2	278.013	359,695	$^5D_1-(^4F)^3D_1$
			$^5D_4-(^4F)^3D_3$
3	278.113	359,566	$^5D_3-(^4F)^5F_4$
7	278.184	359,474	$^5D_4-(^4F)^5F_5$
2	278.298	359,327	$^5D_2-(^4F)^3D_1$
			$^5D_3-(^4F)^3D_2$
1	278.360	359,247	$^5D_2-(^4F)^5F_3$
7	278.632	358,896	$^5D_4-(^4F)^5F_4$
5	278.685	358,828	$^5D_1-(^4F)^5F_2$
6	278.790	358,693	$^5D_3-(^4F)^5F_3$
5	278.981	358,447	$^5D_2-(^4F)^5F_2$

Int.	λ	ν	d^4 — d^34p
2	279.040	358,372	$^5D_0-(^4F)^5F_1$
4	279.210	358,153	$^5D_1-(^4F)^5F_1$
5	279.400	357,910	$^5D_3-(^4F)^5F_2$
7	279.508	357,772	$^5D_2-(^4F)^5F_1$
			$^5D_3-(^4F)^5D_4$
5	279.780	357,424	$^5D_2-(^4F)^5D_3$
7	280.003	357,139	$^5D_4-(^4F)^5D_4$
6	280.060	357,066	$^5D_1-(^4F)^5D_2$
6	280.199	356,889	$^5D_3-(^4F)^5D_3$
4	280.309	356,749	$^5D_0-(^4F)^5D_1$
2	280.350	356,697	$^5D_2-(^4F)^5D_2$
4	280.464	356,552	$^5D_1-(^4F)^5D_1$
3	280.706	356,245	$^5D_4-(^4F)^5D_3$
3	280.775	356,157	$^5D_2-(^4F)^5D_1$
			$^5D_3-(^4F)^5D_2$
8	283.089	353,246	$^3H_6-(^2G)^3G_5$
5	283.405	352,852	$^3H_5-(^2G)^3G_4$
3	283.883	352,258	$^3H_4-(^2G)^3G_3$
5	284.366	351,659	$^3F_4-(^2G)^3G_5$
4	284.885	351,019	$^3F_3-(^2G)^3G_4$
3	285.034	350,835	$^3F_4-(^2G)^3G_4$
3	285.645	350,085	$^3F_2-(^2G)^3G_3$
2	285.713	350,002	$^3F_3-(^2G)^3G_3$
4	287.666	347,625	$^3G_5-(^2G)^3G_5$
4	288.031	347,185	$^3G_4-(^2G)^3G_4$
3	288.509	346,610	$^3G_3-(^2G)^3G_3$
1	295.268	338,675	$^3F_3-(^4F)^3F_4$
4	295.419	338,502	$^3F_4-(^4F)^3F_4$
1	295.976	337,865	$^3F_2-(^4F)^3F_3$
3	296,050	337,781	$^3F_3-(^4F)^3F_3$
1	296.206	337,603	$^3F_4-(^4F)^3F_3$
4	296.719	337,019	$^3F_2-(^4F)^3F_2$
7	296.923	336,788	$^3H_6-(^4F)^3G_5$
7	297.372	336,279	$^3H_5-(^4F)^3G_4$
6	297.651	335,964	$^3H_4-(^4F)^3G_3$
3	298.318	335,213	$^3F_4-(^4F)^3G_5$
3	298.649	334,841	$^3G_4-(^4F)^3F_4$

Int.	λ	ν	d^4 — d^34p
5	298.989	334,460	$^3G_5-(^4F)^3F_4$
			$^3F_3-(^4F)^3G_4$
2	299.051	334,391	$^3G_3-(^4F)^3F_3$
2	299.157	334,273	$^3F_4-(^4F)^3G_4$
5	299.456	333,939	$^3G_4-(^4F)^3F_3$
2	299.586	333,794	$^3F_2-(^4F)^3G_3$
2	299.659	333,713	$^3F_3-(^4F)^3G_3$
5	299.822	333,531	$^3G_3-(^4F)^3F_2$
5	300.537	332,738	$^3P_0-(^4F)^3D_1$
4	301.203	332,002	$^3P_1-(^4F)^3D_2$
0	301.604	331,561	$^3G_4-(^4F)^3G_5$
1	301.713	331,441	$^3P_1-(^4F)^3D_1$
5	301.955	331,175	$^3G_5-(^4F)^3G_5$
0	302.061	331.059	$^3G_3-(^4F)^3G_4$
4	302.123	330,991	$^3P_2-(^4F)^3D_3$
2	302.157	330,954	$^3F_2-(^4F)^3D_3$
1	302.261	330,840	$^3F_3-(^4F)^3D_3$
4	302.408	330,679	$^3F_4-(^4F)^3D_3$
4	302.471	330,610	$^3G_4-(^4F)^3G_4$
3	302.736	330,321	$^3G_3-(^4F)^3G_3$
1	303.071	329,956	$^3P_2-(^4F)^3D_2$
3	303.191	329,825	$^3F_3-(^4F)^3D_2$
2	303.410	329,587	$^3P_0-(^4F)^5D_1$
1	303.565	329,419	$^3P_2-(^4F)^3D_1$
2	303.619	329,360	$^3F_2-(^4F)^3D_1$
3	303.685	329,289	$^3F_2-(^4F)^5F_3$
2	303.943	329,009	$^3F_4-(^4F)^5F_3$
2	304.116	328,822	$^3P_1-(^4F)^5D_2$
0	304.374	328,543	$^3P_2-(^4F)^5F_2$
0	304.531	328,374	$^3F_3-(^4F)^5F_2$
1	304.607	328,292	$^3P_1-(^4F)^5D_1$
4	305.037	327,829	$^3F_2-(^4F)^5F_1$
1	305.322	327,523	$^3P_2-(^4F)^5D_3$
1	305.612	327,212	$^3F_4-(^4F)^5D_3$
1	306.145	326,643	$^3F_3-(^4F)^5D_2$
1	306.567	326,193	$^3F_2-(^4F)^5D_1$

Table II. *Term values of* Co VI.

$d^4\ ^5D_0$	000	$d^4\ ^3F_2$	30545	$d^3(^4F)4p^5F_2$	359,036	$d^3(^4F)4p^3F_3$	368,414
$^5D_1$	208	$^3F_3$	30635	$^5F_3$	359,826	$^3F_4$	369,316
$^5D_2$	586	$^3F_4$	30816	$^5F_4$	360,690	$d^3(^4P)4p^5P_1$	374,556
$^5D_3$	1129	$^3G_3$	34024	$^5F_5$	361,263	$^5P_2$	375,250
$^5D_4$	1789	$^3G_4$	34473	$^3D_1$	359,903	$^5P_3$	376,363
$^3P_0$	27167	$^3G_5$	34852	$^3D_2$	360,462	$d^3(^2G)4p^3G_3$	380,634
$^3P_1$	28458	$d^3(^4F)4p^5D_1$	356,754	$^3D_3$	361,495	$^3G_4$	381,656
$^3P_2$	30504	$^5D_2$	357,279	$^3G_3$	364,343	$^3G_5$	382,477
$^3H_4$	28381	$^5D_3$	358,021	$^3G_4$	365,083	$d^3(^2H)4p^3G_3$	396,579
$^3H_5$	28804	$^5D_4$	358,928	$^3G_5$	366,026	$^3G_4$	396,420
$^3H_6$	29233	$^5F_1$	358,366	$^3F_2$	367,560	$^3G_5$	396,229

[1] I. S. Bowen, Phys. Rev. **47**, 924 (1935) and **52**, 1153 (1937).

figurations and Table II lists the positions of 44 of these terms. This completes the location of the more important low terms of this isoelectronic sequence up to Co VI. In the ions of the VII and somewhat higher stages of ionization of this row of the periodic table the terms of the $3s^23p^63d^{n-1}4p$ configuration become mixed with and distorted by the terms of the $3s^23p^53d^{n+1}$ configuration. This renders the study of these isoelectronic sequences beyond the VI stage difficult and uncertain.

JUNE 1, 1938 PHYSICAL REVIEW VOLUME 53

The Absorption Spectrum of Caesium Hydride

G. M. ALMY AND M. RASSWEILER
Department of Physics, University of Illinois, Urbana, Illinois
(Received April 11, 1938)

A $^1\Sigma\rightarrow{}^1\Sigma$ molecular spectrum of caesium hydride has been photographed in absorption with a three meter glass prism spectrograph. The spectrum is of the many lines type and the observed part lies between 4550A and 6250A. In the longer wave-lengths the bands are masked by a system of Cs_2 bands. The CsH system consists of 31 two-branch bands falling into three v' progressions. There is an additive uncertainty in the v'-numbering. The rotational and vibrational constants have been calculated for the two electronic states. B_v' and $\Delta G'$ show the anomaly characteristic of alkali hydrides, rising with increasing v' to a maximum and then falling off. The heats of dissociation are 1.10 and 1.96 volts for the excited and ground states. Potential energy curves are drawn and it is shown that Mulliken's explanation for the anomalous behavior of the excited states of alkali hydrides fits nicely in the case of CsH.

THE molecular spectra of LiH[1], NaH[2] and KH[3] have already been extensively investigated both in absorption and emission. They are all of the many lines type and in each case the spectrum has been ascribed to a $^1\Sigma\rightarrow{}^1\Sigma$ transition. This system of LiH lies mostly between 3000A and 4500A, that of NaH between 3500A and 5000A, and that of KH between 4100A and 6600A. The determination of the heats of dissociation has indicated in each case that the products of dissociation from the ground state are a normal hydrogen atom and a normal alkali atom, and from the excited state are a normal hydrogen atom and an alkali atom in the first excited ^2P state. The alkali hydrides are of particular interest on account of the anomalies which characterize their excited states. Both B_v' and $\Delta G'$ rise to a maximum then begin to fall off instead of decreasing steadily with increasing v'.

This paper is an account of a similar spectrum of CsH which has been photographed in absorption and lies between 4500A and 6250A. Analysis discloses the same anomalies as have been found in the other alkali hydrides.

EXPERIMENTAL PROCEDURE

The CsH absorption column was formed in a heavy walled steel tube 140 cm in length and 2.5 cm in internal diameter. A taper grease joint near one end made it easy to open the tube for cleaning and loading. Welded side tubes at the ends provided for connection to vacuum pumps, hydrogen supply, manometer and escape valve for excess gas. Pyrex windows were waxed to the ends. Water jackets kept the ends cooled. The tube was heated with nichrome coils in separately controlled units so that the ends of the heated section could be maintained at a higher temperature than the center. This somewhat retarded the diffusion of the vapor to the cool ends of the tube. Temperatures were measured at the center by means of a chromel-alumel thermocouple.

---

[1] F. H. Crawford and T. Jorgensen, Jr., Phys. Rev. **49**, 745 (1936). Contains complete references to earlier literature.
[2] T. Hori, Zeits. f. Physik, **62**, 352 (1930); **71**, 478 (1931).
[3] G. M. Almy and C. D. Hause, Phys. Rev. **42**, 242 (1932). T. Hori, Memoirs Ryojun College of Engineering **6**, 1 (1933).